

Ultra-small nanoprobe arrays could be a leap forward in high-resolution human-machine interfaces

Date: July 3, 2019

Source: University of Surrey

Summary: Machine enhanced humans -- or cyborgs as they are known in science fiction -- could be one step closer to becoming a reality, thanks to new research.

FULL STORY



Brain circuits concept (stock image).

Credit: © *santiago silver / Adobe Stock*

Machine enhanced humans -- or cyborgs as they are known in science fiction -- could be one step closer to becoming a reality, thanks to new research Lieber Group at Harvard University, as well as scientists from University of Surrey and Yonsei University.

Researchers have conquered the monumental task of manufacturing scalable nanoprobe arrays small enough to record the inner workings of human cardiac cells and primary neurons.

The ability to read electrical activities from cells is the foundation of many biomedical procedures, such as brain activity mapping and neural prosthetics. Developing new tools for intracellular electrophysiology (the electric current running within cells) that push the limits of what is physically possible (spatiotemporal resolution) while reducing invasiveness could provide a deeper understanding of electrogenic cells and their networks in tissues, as well as new directions for human-machine interfaces.

In a paper published by *Nature Nanotechnology*, scientists from Surrey's Advanced Technology Institute (ATI) and Harvard University detail how they produced an array of the ultra-small U-shaped nanowire field-effect transistor probes for intracellular recording. This incredibly small structure was used to record, with great clarity, the inner activity of primary neurons and other electrogenic cells, and the device has the capacity for multi-channel recordings.

Dr Yunlong Zhao from the ATI at the University of Surrey said: "If our medical professionals are to continue to understand our physical condition better and help us live longer, it is important that we continue to push the boundaries of modern science in order to give them the best possible tools to do their jobs. For this to be possible, an intersection between humans and machines is inevitable.

"Our ultra-small, flexible, nanowire probes could be a very powerful tool as they can measure intracellular signals with amplitudes comparable with those measured with patch clamp techniques; with the advantage of the device being scalable, it causes less discomfort and no fatal damage to the cell (cytosol dilation). Through this work, we found clear evidence for how both size and curvature affect device internalisation and intracellular recording signal."

Professor Charles Lieber from the Department of Chemistry and Chemical Biology at Harvard University said: "This work represents a major step towards tackling the general problem of integrating 'synthesised' nanoscale building blocks into chip and wafer scale arrays, and thereby allowing us to address the long-standing challenge of scalable intracellular recording.

"The beauty of science to many, ourselves included, is having such challenges to drive hypotheses and future work. In the longer term, we see these probe developments adding to our capabilities that ultimately drive advanced high-resolution brain-machine interfaces and perhaps eventually bringing cyborgs to reality."

Professor Ravi Silva, Director of the ATI at the University of Surrey, said: "This incredibly exciting and ambitious piece of work illustrates the value of academic collaboration. Along with the possibility of upgrading the tools we use to monitor cells, this work has laid the foundations for machine and human interfaces that could improve lives across the world."

Dr Yunlong Zhao and his team are currently working on novel energy storage devices, electrochemical probing, bioelectronic devices, sensors and 3D soft electronic systems. Undergraduate, graduate and postdoc students with backgrounds in energy storage, electrochemistry, nanofabrication, bioelectronics, tissue engineering are very welcome to contact Dr Zhao to explore the opportunities further.

Story Source:

Materials provided by **University of Surrey**. *Note: Content may be edited for style and length.*

Journal Reference:

1. Yunlong Zhao, Siheng Sean You, Anqi Zhang, Jae-Hyun Lee, Jinlin Huang, Charles M. Lieber. **Scalable ultrasmall three-dimensional nanowire transistor probes for intracellular recording**. *Nature Nanotechnology*, 2019; DOI: 10.1038/s41565-019-0478-y

Cite This Page:

MLA

APA

Chicago

University of Surrey. "Ultra-small nanoprobes could be a leap forward in high-resolution human-machine interfaces." ScienceDaily. ScienceDaily, 3 July 2019. <www.sciencedaily.com/releases/2019/07/190703121358.htm>.

RELATED STORIES**Nanomaterials Give Plants 'Super' Abilities**

Apr. 3, 2019 — Science-fiction writers have long envisioned human-machine hybrids that wield extraordinary powers. However, 'super plants' with integrated nanomaterials may be much closer to reality. Today, ... [read more »](#)

Nanobot Pumps Destroy Nerve Agents

Aug. 21, 2018 — Once in the territory of science fiction, 'nanobots' are closer than ever to becoming a reality, with possible applications in medicine, manufacturing, robotics and fluidics. Today, scientists report ... [read more »](#)

Research Road Map for Brain-Computer Interfaces

May 26, 2015 — Research and science fiction has been fascinated by brain-machine or brain-computer interfaces – BCI for short – since the early 1970s. Quite apart from cyborgs and the game industry, the most ... [read more »](#)

Identifying 'Stance Taking' Cues to Enable Sophisticated Voice Recognition

Oct. 28, 2014 — In the future, computers may be capable of talking to us during meetings just like a remote teleconference participant. But to help move this science-fiction-sounding goal a step closer to reality, ... [read more »](#)